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A Summary of Current Program and  
Preliminary Report of Progress

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HOME ECONOMICS RESEARCH  
of the  
United States Department of Agriculture  
and cooperating agencies

This progress report of U.S.D.A. and cooperative research is primarily a tool for use of scientists and administrators in program coordination, development and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

There is included under each problem area in the report, a brief and very general statement on the nature of the research being conducted by the State Agricultural Experiment Stations and the professional manpower being devoted by the State stations to such research. Also included is a brief description of related work conducted by private organizations. No details on progress of State station or industry research are included except as such work is cooperative with U.S.D.A.

The summaries of progress on U.S.D.A. and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members and others having an interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of U.S.D.A. and cooperative research issued during the last two years. Current agricultural research findings are also published in the monthly U.S.D.A. publications, Agricultural Research, Agricultural Marketing, and The Farm Index.

UNITED STATES DEPARTMENT OF AGRICULTURE

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## OTHER COMMODITY AND FUNCTIONAL REPORTS

A progress report similar to this one is prepared for use by each of the following research and marketing advisory committees:

Citrus and Subtropical Fruit	Rice
Cotton and Cottonseed	Sheep and Wool
Dairy	Sugar
Deciduous Fruit and Tree Nut	Tobacco
Forage, Feed and Seed	Vegetable
Forestry	Economics
Grain	Farm Equipment and Structures
Livestock	Food and Nutrition
Oilseeds and Peanut	Food Distribution
Potato	Soils, Water and Fertilizer
Poultry	Transportation and Storage

Two additional reports of progress are prepared in order to make available the complete research program. They are:

Ornamentals and Other Miscellaneous Commodities  
Other Research - Cross Commodity

## ORGANIZATIONAL UNIT REPORTS

All of the material in the commodity and functional reports listed above is the same as that found in the 20 division and 3 service research reports listed below.

### Agricultural Research Service (ARS)

Agricultural Engineering  
Animal Disease and Parasite  
Animal Husbandry  
Crops  
Entomology  
Soil and Water Conservation  
Utilization -- Eastern  
Utilization -- Northern  
Utilization -- Southern  
Utilization -- Western  
Human Nutrition  
Clothing and Housing  
Consumer and Food Economics

### Agricultural Marketing Service (AMS)

Market Quality  
Transportation and Facilities

### Economic Research Service (ERS)

Farm Economics  
Marketing Economics  
Economic & Statistical Analysis  
Foreign Development & Trade Analysis  
Foreign Regional Analysis

### Other Services

Farmer Cooperative Service (FCS)  
Forest Service (FS)  
Statistical Reporting Service (SRS)

A copy of this report or any of the others listed above may be requested from David J. Ward, Executive Secretary, Home Economics Research Advisory Committee, Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.

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## GENERAL INTRODUCTION

This is ONE part of a FOUR part report of cooperative U.S.D.A. research on home economics.

This part of the Home Economics report deals with some of the research conducted by the Agricultural Engineering Research Division of the Agricultural Research Service. The other parts cover all of the Department's nutrition and consumer-use research. Only a brief description of the related work of the State Experiment Stations and industry is included.

Under each of the Problem Areas there is a statement describing the program of work underway and the professional man-years devoted to the major kinds of research included. The relative scope of the total research effort on home economics is indicated by the approximate number of professional man-years employed; 132 by U.S.D.A., 194 by the State Experiment Stations, and 845 by industry and other organizations.

### Research by USDA

Home Economics as used in this report covers research to define basic needs and wants of people for goods and services for daily living, to evaluate the contributions that various kinds of goods and services can make to satisfying these needs, to make periodic studies of levels of consumption by different economic and regional groups, to determine gaps between needs and consumption and suggest ways in which these gaps may be filled, and to gain better understanding of human development and problems of living together in families, communities, and nations. It is consumer-oriented research that seeks to provide the help that families need in selecting and using goods and services, in managing their money and time, and in developing and conserving their human resources. Its results should also provide producers with important guides in bringing to market goods that are satisfying to consumers.

Home economics research involves physical, biological, and social sciences and is carried out by three Agricultural Research Service Divisions -- Clothing and Housing, Consumer and Food Economics, and Human Nutrition. During the past fiscal year about 125 professional man-years were devoted to this research.

Agricultural engineering studies relate the development of farmhouse designs, with consideration given to design criteria for comfort, health, and safety. Materials and construction for rural dwellings

are studied as are systems for environmental control, including house heating and cooling equipment. In addition, attention is given to ways to secure and maintain adequate and safe water supplies and to suitable methods of waste disposal. Approximately 7 professional man-years were devoted to this work during the past fiscal year.

#### Research by State Experiment Stations

There is included under each problem area a brief and very general statement on the nature of the research being conducted by the State Agricultural Experiment Stations and the professional manpower being devoted by the State stations to such research.

Consolidating this information for the entire field of interest, we find that in fiscal year 1962, a total of about 194 man-years were spent by the State Agricultural Experiment Stations on home economics research.

Among the human nutrition and food problem areas, the professional man-years were divided as follows: functions and metabolism of nutrients, 35; relations of nutrition to physiological, genetic and environmental factors, 11; human metabolism of nutrients, 28; nutrient requirements and nutritional status of humans, 16; nutrient composition of foods, 18; biological value of foods, 7; consumer use qualities as related to inherent properties of foods, 5; and household use of foods, 22. Contributions were made to seven regional research projects.

Problems concerned with clothing, household textiles, and fabrics for consumer use received research attention to the extent of about 13 professional man-years. About 1 professional man-year was devoted to household maintenance of textile products. Four regional studies, including both basic and applied research, were included in these investigations.

In the area of rural family housing and household operations, the researches totaled about 10 professional man-years. Three regional housing studies contributed much of the effort in housing research.

Work in the area of household equipment amounted to 1 professional man-year.

Of the professional man-years involved in household economics research, in 1962, about 3 applied to the conduct of research on food economics and diet appraisal, and 8 to the area of family economics. One regional investigation was included in the latter area of research.



Approximately 16 professional man-years were devoted to other home economics and family life researches in the State Experiment Stations.

No details on progress of State station research are included in this report except as such work is cooperative with the U.S.D.A.

#### Summary of Research by Industry and Other Organizations

Research is conducted by manufacturers and trade associations concerned with such things as textiles, household equipment, interior finishes for homes, and products for household maintenance and care. Among others, food processors, their suppliers, and trade organizations devote considerable attention to determining food constituents for use as control indices and to developing recommendations for consumer use of products.

Industry will continue to supplement public and non-profit development and standardization of test procedures.

Food trade groups and other private organizations prepare materials for nutrition education or for aiding families in financial management problems.

It is estimated that the total research effort approximates 845 professional man-years.



## RURAL DWELLINGS

Agricultural Engineering Research Division, ARS

Problem. Incomplete reports from the 1960 Census of Housing indicate that although about 500,000 new farmhouses were built between 1950 and 1960 rural housing as a whole continues to be older than and inferior to urban housing in condition and value of buildings and in availability of plumbing, heating, and labor-saving equipment. Projections of incomplete data indicate that the percentage of farmhouses with flush toilets increased from 27 percent to between 50 and 60 percent between 1950 and 1960, and that the percentage without piped water supply was reduced from 55 percent to about 20 percent in the same period. However, the improvement in these percentages was due partly to change in the Census definition of a farm which removed from the "farmhouse" classification of the Census some 2 million houses on small acreages or on land that had been consolidated into larger holdings. Many of these homes must now be included in the rural "non-farm" category. But whether classified as "farm" or "non-farm" large numbers of houses outside of cities and towns remain without the conveniences and comfort features of typical urban homes.

Housing costs are still a major obstacle for farm families that wish to make improvements for themselves or to furnish better housing to attract and hold qualified and reliable tenants or full-time or migratory workers. Costs are also a problem for the rural non-farm family. Continuing research is needed on ways to reduce costs through better use of space and improved application of old and new materials. There is need for more simple, really low-cost designs that provide only the minimum essentials of good housing; and the "shell house" should be studied for further improvement of its first stage and to make completion easier.

On the other hand, the stepped-up Farmers Home Administration program of rural housing loans needs research support to provide designs that will meet modern housing standards at moderate cost and be sound and desirable security for 30-year government loans. The design and equipment of houses for improved control of temperature and moisture, and economy of operation and maintenance also need further research.

With the rapid increase of the non-farm population in rural areas outside of villages, including many elderly and retired people, more attention should be given to their housing. People who have vegetable gardens and garden equipment to store, and who live on small acreages, drawing water from wells and using septic tank sewage disposal systems, have housing problems very like those of farmers, and the housing abilities of the Department could be very useful to them. Engineering research and design of equipment for the elderly is also needed.

In view of the continuing and expanding "cold war", consideration should be given to types of both farm and non-farm houses that would provide shelter from fallout if an emergency should develop. Basements could provide fallout shelter at small additional cost for families that do not have to care for livestock. Development of types of houses having the basement as an attractive area for full-time use is a challenging problem and would be a valuable achievement. On livestock farms, the family fallout shelter probably should be in the main livestock building.

#### USDA PROGRAM

The U. S. Department of Agriculture is conducting a continuing program of housing research involving engineers and architects.

Five experimental houses at the Agricultural Research Center are under continuing evaluation of design, temperature control features and occupant reaction, in cooperation with Clothing and Housing Research Division, ARS. Construction methods and materials and temperature control are studied at Beltsville and at Athens in cooperation with the University of Georgia. Architectural design and preparation of farmhouse plans for the Cooperative Farm Building Plan Exchange and related publications are carried on at Beltsville in cooperation with Clothing and Housing Research Division, ARS, and the Federal Extension Service. The State Agricultural Colleges cooperate through Regional Committees in establishing housing requirements and making the plans available to the public. Farmers Home Administration consults on requirements and makes plans available to its clients.

Federal work in this Research Area totaled 5.8 professional man-years in 1961. Of this number, 3.0 were devoted to design criteria for comfort, health and safety; 0.4 to studies of materials and construction; 0.3 to systems for environmental control; 1.7 to development and preparation of improved farmhouse designs; and 0.4 to program leadership.



## RELATED PROGRAMS OF STATE EXPERIMENT STATIONS AND INDUSTRY

State Stations in 1961 reported 2.2 professional man-years on dwellings, including an estimated 0.6 on equipment for environmental control (Area 13). These studies were part of Cooperative Regional Projects NC-9, "Utilization of Materials to Meet Housing Needs", and S-8, "Functional Requirements for Southern Rural Homes". Part of the work on materials, construction and plan development reported in Research Area 10 applies to dwellings.

Industry did not report specific research on farm housing, but manufacturers of building materials and of mechanical and electrical equipment carry on development of new products, many of which will prove valuable on the farm. An estimated 5 professional man years per year would apply to farmhouses.

## REPORT OF PROGRESS FOR USDA AND COOPERATIVE PROGRAMS

In cooperation with Clothing and Housing Division, ARS, a study was conducted in five states having active Farmers Home Administration programs to determine the importance of various field construction problems and the need for plans and planning aids. This survey showed the need for better winter heating and summer cooling in existing farmhouses, for reduction of building costs, and for better ways of getting building information to farm people. Work on these problems is being started at Athens and Beltsville. Since farmhouses are currently being built at the rate of only about 12 houses per 1,000 farms per year, it is evident that improvement of existing houses must be relied upon if an appreciable portion of farm families are to benefit within the near future.

Preliminary analysis of data taken in four of the experimental houses at Beltsville in 1961 indicates that greater air temperature stratification occurred in the houses with unheated concrete slab floors and insulated ceilings in combination with no cold air return ducts. A wooden floor above crawl space with cold air return ducts and insulated walls and ceiling provided the least stratification. House D, with warm air flues in the perimeter of the concrete slab and an insulated ceiling, performed well although the brick walls were not insulated. Temperature drop through walls with construction that permitted high infiltration into the insulated stud space indicated a loss in insulation efficiency.



A bedroom addition, including several experimental features, has been designed for House D. This should provide information on the livability and environmental performance of certain building materials and on a heat distribution system using the space between plywood floor and concrete slab as a plenum.

An examination of a four-inch bituminized fiber sewer pipe laid seven years ago to a depth of 39 inches in heavy clay soil near the foundation wall of House E at Beltsville revealed that the pipe had flattened only 1/8 inch thus providing very satisfactory service.

At Athens an automatic, data-logging weather station has been developed to record weather data needed in housing environment studies. It is currently collecting data on the following nine weather factors: Dry bulb temperature, dewpoint temperature, total hemispherical radiation, wind velocity, wind direction, black globe temperature, precipitation, soil temperature and soil moisture. Transducers to measure net hemispherical radiation, evaporation and barometric pressure will be added. The station logs one complete set of data each half-hour in the form of a punched IBM card which can be used for direct computer analysis and columnar print-out of data. This should save a great deal of time in analyzing results of the housing studies. Manuscript for a bulletin describing the weather station, circuitry for all sensing elements, and digitizing and punch card equipment hook-ups, is being prepared as similar equipment would be useful for many other purposes.

Thirteen farmhouse plans released between April 1, 1960 and March 31, 1962, were designed for a wide range of economic needs, and geographic adaptability to meet specific requests of the Regional Plan Exchange Committees. The plans include two for minimum houses without bedrooms, one for a relatively large one-bedroom farmhouse, three for two-bedroom farmhouses (two with basement), five for three-bedroom farmhouses (one with basement), and two for four-bedroom farmhouses (one with basement). Liberal space allowances are designed into two of the three-bedroom plans, and one of the four-bedroom plans. The other plans are designed for modest cost of erection at the sacrifice of space.

PUBLICATIONS REPORTING RESULTS OF USDA AND COOPERATIVE RESEARCH

Design Criteria

Biggs, Archie A., and Courtless, Joan. 1961. Evaluation of construction, materials, and livability of five expansible farmhouses. USDA ARS Series 42-45.

Thompson, Harold J., and Simons, Joseph W. 1961. Some effects of construction and climatic factors on heating five expansible farmhouses. USDA ARS Series 42-46.

Home sewing areas. 1961. Supplement A to Southern Cooperative Series Bulletin No. 58.

Farmhouse Plan Leaflets

One bedroom farmhouse. (Exchange Plan No. 7146). USDA Misc. Pub. No. 826, August 1960.

Two bedroom farmhouse with Beltsville kitchen. (Exchange Plan No. 7149). USDA Misc. Pub. No. 827, August 1960.

Two bedroom farmhouse - slab-on-grade. (Exchange Plan No. 7158). USDA Misc. Pub. No. 828, August 1960.

Three bedroom farmhouse with Beltsville kitchen. (Exchange Plan No. 7152). USDA Misc. Pub. No. 829, October 1960.

Two bedroom farmhouse with basement. (Exchange Plan No. 7157). USDA Misc. Pub. No. 830, October 1960.

Three bedroom farmhouse with attached two-car garage. (Exchange Plan No. 7132). USDA Misc. Pub. No. 842, March 1961.

HOUSE HEATING AND COOLING EQUIPMENT  
Agricultural Engineering Research Division, ARS

Problem. Research and practical experience have shown that temperature is one of the factors affecting the well being of occupants of homes. Information is needed on efficient ways to modify environmental conditions in farm homes.

USDA PROGRAM

A continuing basic and applied program is underway in cooperation with the Kansas Agricultural Experiment Station on solar energy collection and storage for supplemental heat energy to air-source heat pumps for house heating. Solar energy collection and storage for direct house heating has been studied at Athens, Georgia.

The Federal scientific effort devoted to research in this area totals 1.4 professional man-years.

RELATED PROGRAMS OF STATE EXPERIMENT STATIONS AND INDUSTRY

State Experiment Stations in 1961 reported an estimated total of 9.6 professional man-years of research on heating, cooling, ventilating, and air-conditioning equipment for modification of environment for livestock, crops and growing plants.

Industry research effort on electrical facilities and fixtures specifically for installation in farm buildings is only a very minor portion of the overall industry program, the major portion being for industrial and other non-farm structures. Functional requirements and design criteria resulting from State and Federal research are largely used by industry for guidance in farm application of equipment for environmental control. Estimated animal research expenditures are equivalent to less than 5 professional man-years.

REPORT OF PROGRESS FOR USDA AND COOPERATIVE PROGRAMS

House Heating and Cooling Equipment. In Kansas a comparison of a solar-supplemented and a conventional air-to-air type heat pump has been accomplished for the first essentially complete (93 percent of total degree days) heating season from November 1960 to May 1961. The solar-supplemented system consists of 800 square feet of vertical south-facing solar collectors; an underground rock heat storage with 50 cubic yards of limestone rock passing a 2 1/2-inch screen and retained on a 1-inch screen; associated electrical and electronic controls; and an air-to-air heat pump. The solar supplemented heat pump system operated at an average performance factor 13.5 percent higher than the conventional heat pump system with maximum and



minimum increases of 30 and 2 percent respectively.

Criteria on automatic controls to maximize performance are being analyzed but the functional requirements for controls to maximize performance are not yet fully developed. Selection and integration of control elements into an automatic system to economically accomplish the above objective must necessarily follow this functional clarification.

A selected area of the ground surface was insulated above the storage system and is being compared to a similar uninsulated section. A partial summary of data taken in December 1961 showed that the average rate of heat flow from the ground was greater by a factor of 2 to 2 1/2 for the uninsulated as compared to the insulated section. The open-plenum section of the storage system was insulated during initial construction with two inches of cork placed on top of the rock storage and then covered with about three feet of earth. The data indicate that the heat flow transducer should be placed at the storage level to adequately indicate heat exchange between storage and earth.

A significant contribution of the solar supplemented system has been the reduction of defrosting requirements. Data show an overall increase, due to solar supplementation, of 65 to 70 percent (55 to 60 percent 1959-60) in the heat pump operating hours before defrosting was required.

Modified types of collector cover construction appear to be durable and thus far have given satisfactory service. Observations indicate that the design using horizontal bowed wooden braces (rather than both horizontal and vertical braces) provides a better method of holding the nylon reinforced film plastic cover in tension and away from the metal absorber surface during windy or changeable temperature weather.

In cooperation with the Kansas Committee on the Relationship of Electricity to Agriculture, technical consultation, provision of equipment, and instrumentation and assistance are being rendered in a research project using a solar supplemented preheater with an electric water heater. A photoelectric switch is used to control a water pump for the purpose of collecting solar heat energy. Temperature, B.t.u., heat, and electric energy meters and pyrheliometer records are providing data to analyze the performance of the system.

In Georgia, first year studies of solar energy collection for supplemental heating of rural dwellings indicated that it was not feasible. A heat storage was then incorporated in the system for the 1960-61 tests. The savings with the heat storage in operation were unsatis-

factory because: (1) Resistance to air flow through the crushed rock, used for heat storage, was greater than estimated, reducing the rate of air flow and the collector efficiency and (2) too great an imbalance was allowed in the heat storage capacity and collector output for long periods of cloudy weather.

Crushed rock samples were screened to various sizes and resistance-to-air-flow tests were run to provide information needed in sizing the blower and motor. Tests indicated that finned collector plates gave about 30 percent greater efficiency than unfinned plates. These improvements have been incorporated in a new combination solar collector and heat storage and heating tests are underway.

#### PUBLICATIONS REPORTING RESULTS OF USDA AND COOPERATIVE RESEARCH

##### House Heating and Cooling Equipment

- Davis, Jr., C. P. and Lipper, R. I. Heat pumps. Agricultural Engineering Handbook, McGraw-Hill Company, pp. 714-718. 1961
- Davis, Jr., C. P., and Mowry, G. R. Operational characteristics of a solar supplemented air-type heat pump. A Progress Report, Kansas Committee on the Relation of Electricity to Agriculture, Thirty-Sixth Annual Report. 1960.
- Mowry, G. R., and Davis, Jr., C. P. A solar supplementally heated home. A Progress Report, Kansas Committee on the Relation of Electricity to Agriculture, Thirty-Seventh Annual Report. 1961.
- Simons, J. W., and Haynes, Jr., B. C. Solar radiation for heating farm homes. Georgia Agricultural Research, Winter 1961. 1961.



WATER SUPPLY AND WASTE DISPOSAL  
Agricultural Engineering Research Division, ARS

Problem. An adequate supply of satisfactory water is essential to the farmstead. Automatic running-water systems, more water-using equipment, new uses for water, higher standards of sanitation, and other factors are continually increasing the demand for water on the farmstead--both in quantity and quality. The "old well" is less and less able to satisfy the demand. Some farm operators have been forced to buy water by the tank or truck load at considerable cost; others are developing farm ponds as sources of farmstead water; some continue to operate with a supply that is becoming less and less adequate.

Surface waters normally require disinfection as a safeguard against water-borne diseases such as typhoid, dysentery, other gastro-intestinal disorders, and infectious hepatitis. Often they also require filtration and other treatment to remove undesirable foreign material. Deeper ground waters are often highly mineralized (hardness, iron, sulphur, and others), and expensive or impossible to treat adequately. Data on water demands and water systems requirements of the modern farmstead are needed to guide farmers in planning water systems and selecting equipment, to enable extension workers to adequately advise farmers, and to guide equipment and appliance manufacturers and sanitary code-making bodies. Simpler, more reliable, and less costly methods and equipment are needed for treating farmstead water supplies to improve their quality.

Disposal of organic wastes--principally sewage and manures--is becoming more and more of a problem on the modern farmstead. Economical, sanitary means of disposition need to be developed. Among means to be investigated are lagoons, irrigation systems, subsurface absorption systems and reclamation. Development of improved methods for disposing of sewage in those rural areas where conditions are adverse to the conventional septic tank system (high ground water, shallow rock, and non-absorptive soils, restricted areas) is needed.

USDA PROGRAM

This is a continuing long-term program involving engineers. It is cooperative with selected State Agricultural Experiment Stations.

Water supply and wastes disposal for the farmstead are studied at College Park, Md., in cooperation with the Maryland Agricultural Experiment Station. Liaison is maintained with the Public Health Service, the Water Systems Council, American Society of Agricultural Engineers, and other organizations concerned with rural sanitation.

The Federal effort in this research area totals 1.4 professional man-years.

#### RELATED PROGRAMS OF STATE EXPERIMENT STATIONS AND INDUSTRY

State Experiment Stations in 1961 reported a total of 2.8 professional man-years divided among subheadings as follows: water supply, 1.3; and manure and waste disposal, 1.5.

Water supply investigations are in progress in the North Central and Southern Regions to provide potable water supplies for farm home use from ponds and to reduce mineral content of sub-surface waters. These investigations are seeking economical ways to combine filters, membranes, sterilization apparatus such as chlorinators and germicidal lamps and ion exchange equipment. Manure and waste disposal investigations are in progress in the North Central, Northeastern, and Western Regions on the use of lagoons for disposing of these wastes. Included in the studies are design and development of special equipment and facilities for automatic transfer of the material to the disposal facility and cooperative laboratory examinations to determine the bacteriological and bio-chemical aspects of the waste materials. The studies are a part of Cooperative Regional Project NC-48, "Development of Materials Handling Systems for North Central Farms".

Water supply equipment manufacturers and trade associations are engaged in product development and improvement research on broad lines of equipment--only a small portion of which has specific application to the farm. It is estimated that less than 5 professional man-years are devoted to this portion.

Wastes disposal equipment manufacturers devote little or no research effort specifically to disposal of wastes from farm houses or service buildings. A number of manufacturers of chemical toilets, incinerators, patented sewage disposal devices and related items are engaged in development and improvement research on some products that have some application to the farm. The estimated effort is less than 5 professional man-years.

#### REPORT OF PROGRESS FOR USDA AND COOPERATIVE PROGRAMS

Studies on farmstead water demand and requirements for water supply systems are in progress in Maryland, in cooperation with the Agricultural Experiment Station. An automatic data recording system has been developed and satisfactorily field tested on a 40-cow dairy farm. The system both collects and tape records water use data automatically. It has 12 counters which can continuously measure and record the water use at 12 points in the system.

Wastes disposal studies in cooperation with the Maryland Agricultural Experiment Stations have indicated that a properly designed "lagoon" could provide an economical method of handling and disposing of livestock manures. However, observations of a number of farm lagoons which are not operating properly show need for the establishment of design factors which include the area necessary per animal unit as well as the depth necessary for proper bacterial action.

In cooperation with the Maryland Agricultural Experiment Station a holding trench-lagoon combination was designed and installed on the farm of a cooperator. The holding trench is adjacent to a feeding floor for hogs and is large enough to hold 10 to 14 days' flushings from that floor. When full, a bottom plug is pulled and the contents are drained into a pond used as a disposal lagoon, having an area of 100 square feet per animal. Observations thus far have noted no fish kill and the area immediately adjacent to the point where the effluent enters the pond has remained open during the winter while the rest of the pond and the holding trench were frozen over. Although some bedding was flushed into the system, none was observed floating on the pond as has been observed where the flushings go directly to the lagoon. Further work will determine the effect of the holding trench in the initial digestion of the waste material.

Instruments have been designed to determine the biochemical oxygen demand of various agricultural waste materials and to determine the sulfate content of the water used in flushing material into the lagoon. This factor may be responsible for a buildup of the sulfate content in the lagoon and causing an odorous condition.

#### PUBLICATIONS REPORTING RESULTS OF USDA AND COOPERATIVE RESEARCH

##### Water Supply and Wastes Disposal

- Bailey, W. A. 1960. Fan and pad system of cooling greenhouses and other farm buildings. Paper No. NA 60-48, presented at North Atlantic Section, ASAE, Amherst, Massachusetts, August 22-24.
- Eby, Harry J. 1961. Design criteria and management for manure lagoons. Paper No. 61-935, presented at Winter Meeting, ASAE, Chicago, Illinois, December 12-15.

